



Armed Forces College of Medicine AFCM



General plan of Kidney & Structure of Renal corpuscle

Prof. Dr. Mona H. Raafat
Histology Department

INTENDED LEARNING OBJECTIVES (ILO)



By the end of this lecture the student will be able to:

- 1- Describe** the general structure of the kidney.
- 2- Describe** the microscopic structure (LM & EM) of the renal corpuscle (Bowman's capsule & glomerular capillaries)
- 3- Correlate** the microscopic structure of Bowman's capsule and glomerular capillaries to their function.
- 4- Analyse** the structure of the blood renal barrier.
- 5- Interpret** the histological changes of the glomerular structure in different diseases.

Key Points



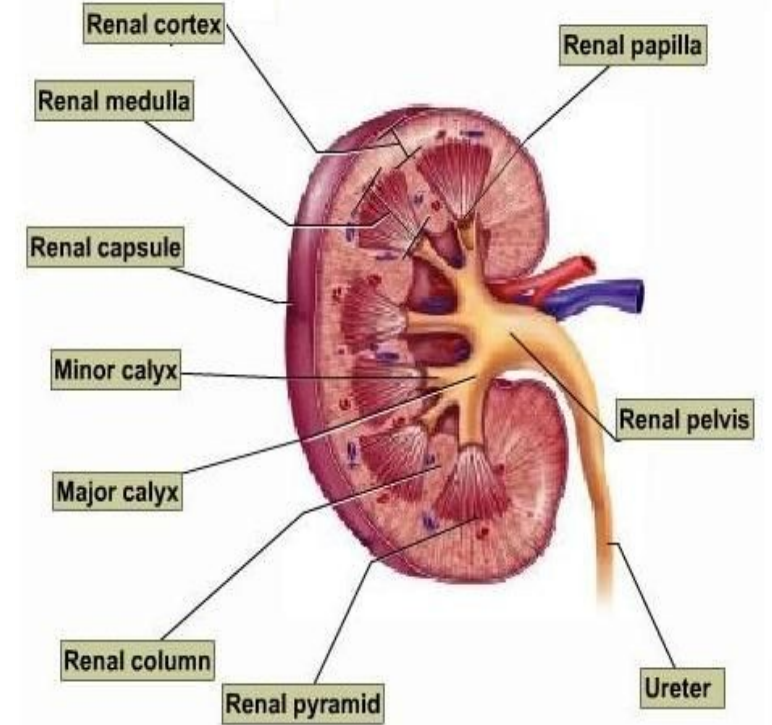
- Definition of Renal Pyramids, Columns of Bertin, Medullary rays, Renal lobes & Renal lobules.
- Difference between Uriniferous tubule & Nephron.
- Components of the Nephron.
- Histological structure of Renal Corpuscle
- The difference between Parietal and Visceral layer of Bowman's capsule.
- Histological structure of the glomerular capillaries
- Correlation between the histological structure of Blood Renal barrier and its function with reference to its medical application.

Kidney



General structure:

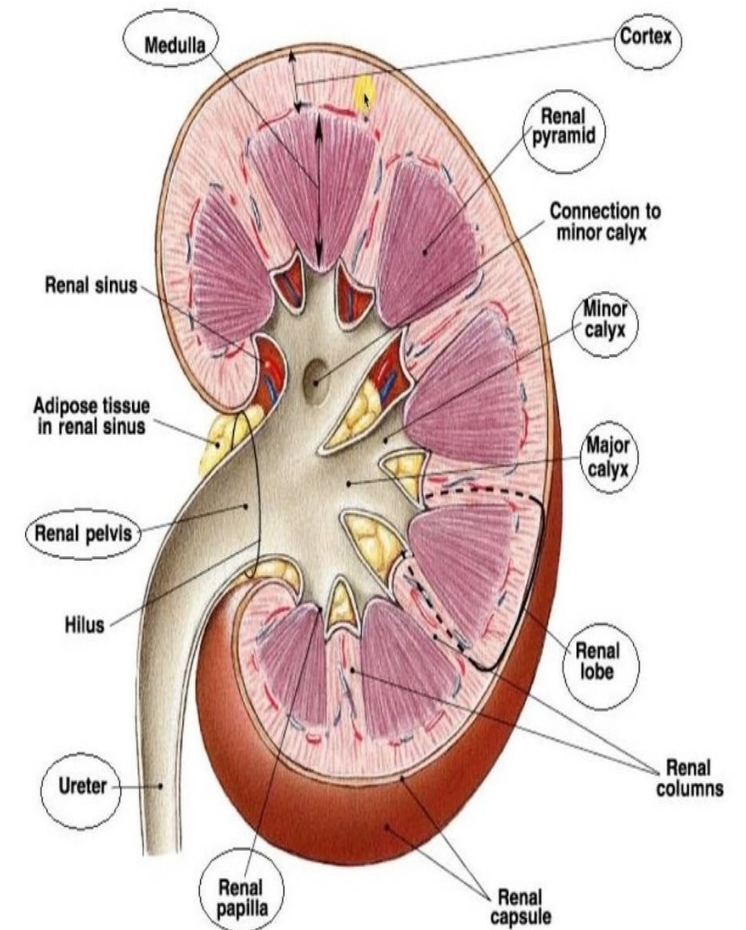
- It is a bean- shaped paired organ.
- It is divided into outer cortex and inner medulla.
- The renal cortex is reddish and granular, contains **renal corpuscles** and **convoluted tubules**.
- The medulla is light grey, formed of **renal pyramids** whose apex is directed towards the renal pelvis.



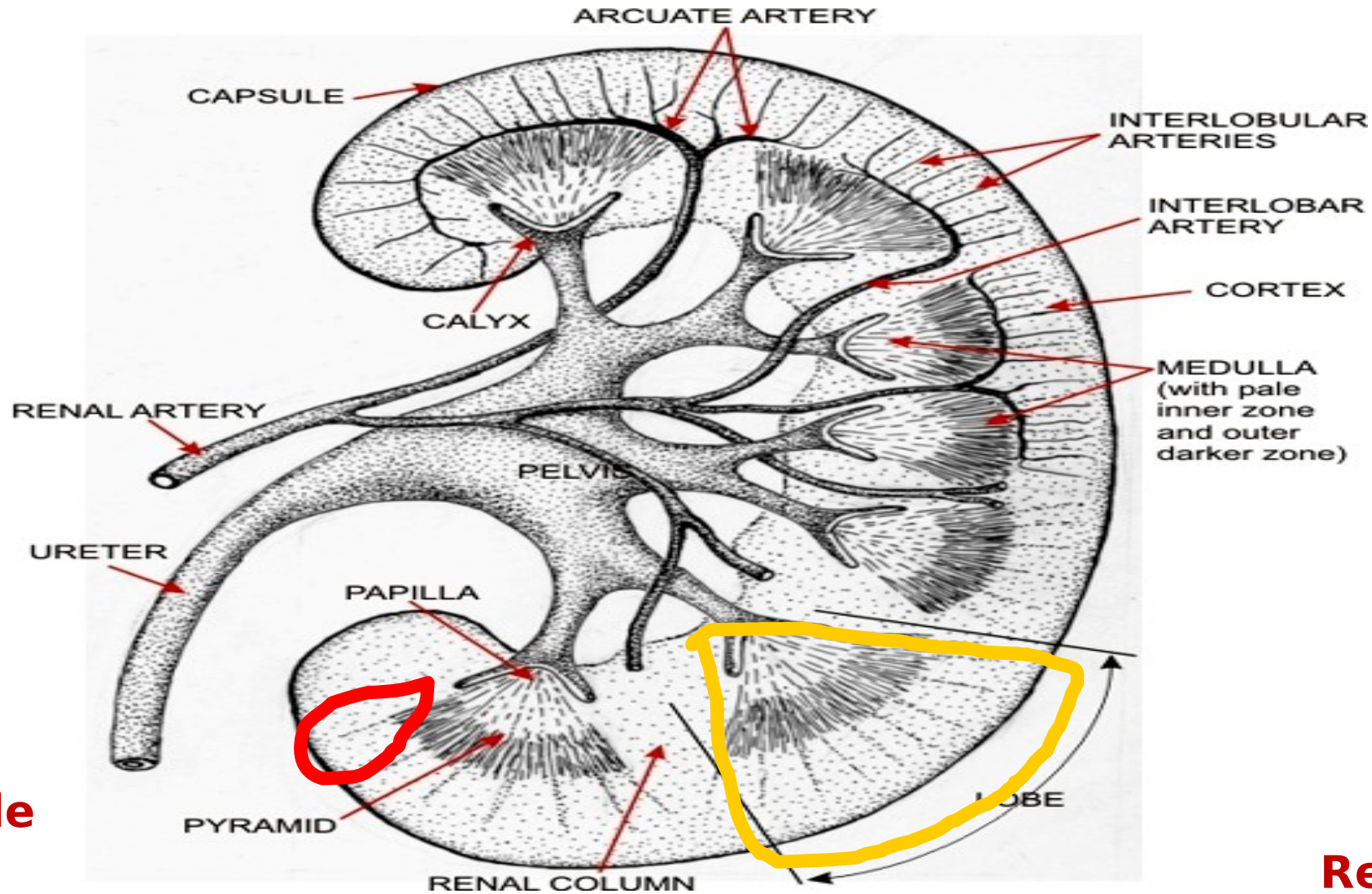
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- The medulla contains the **collecting tubules** and **loop of Henle**.
- **Columns of Bertin** are cortical tissue between medullary pyramids.
- **The medullary rays** are the straight tubules extending from the base of medullary pyramids into the cortex.



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Renal lobule
(**medullary ray** with
surrounding
cortical tissue)

Renal lobe
(**renal pyramid** with
surrounding
cortical
tissues)

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- Histologically, it is **compound tubular gland** formed of:

- **Stroma:**

- **Capsule:** loosely attached to the Kidney

- **Reticular C.T.** supporting the parenchyma

- **Parenchyma:** it represented by **"Uriniferous tubules"** which is the functional unit of the kidney

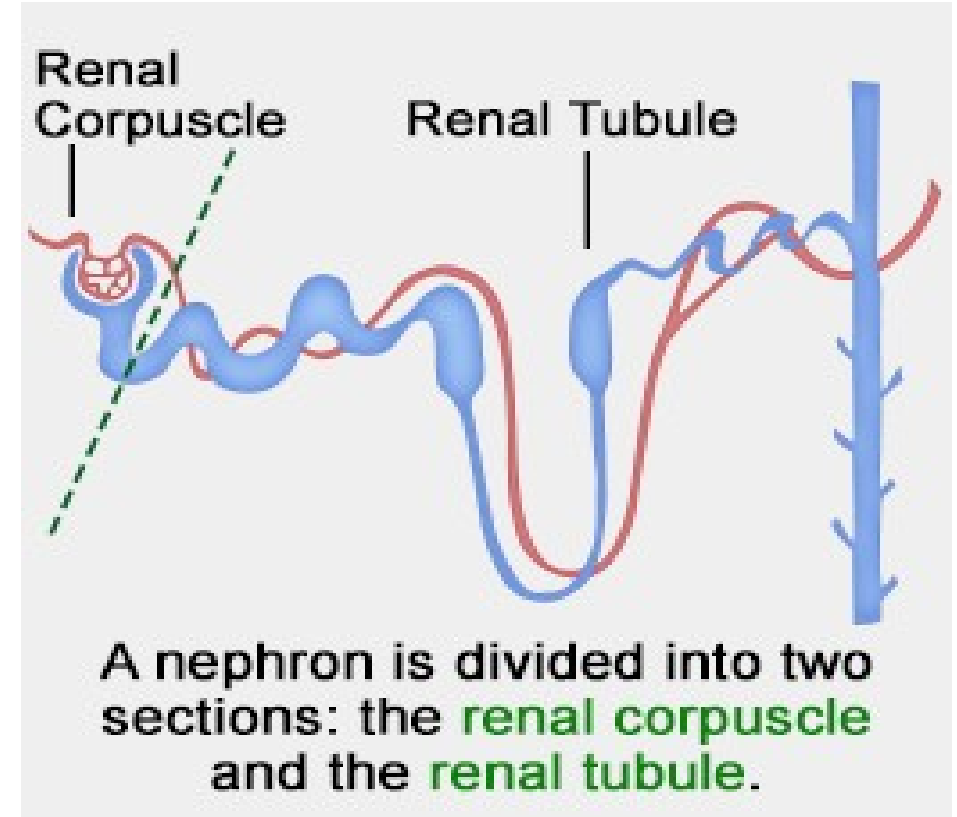
Uriniferous Tubules



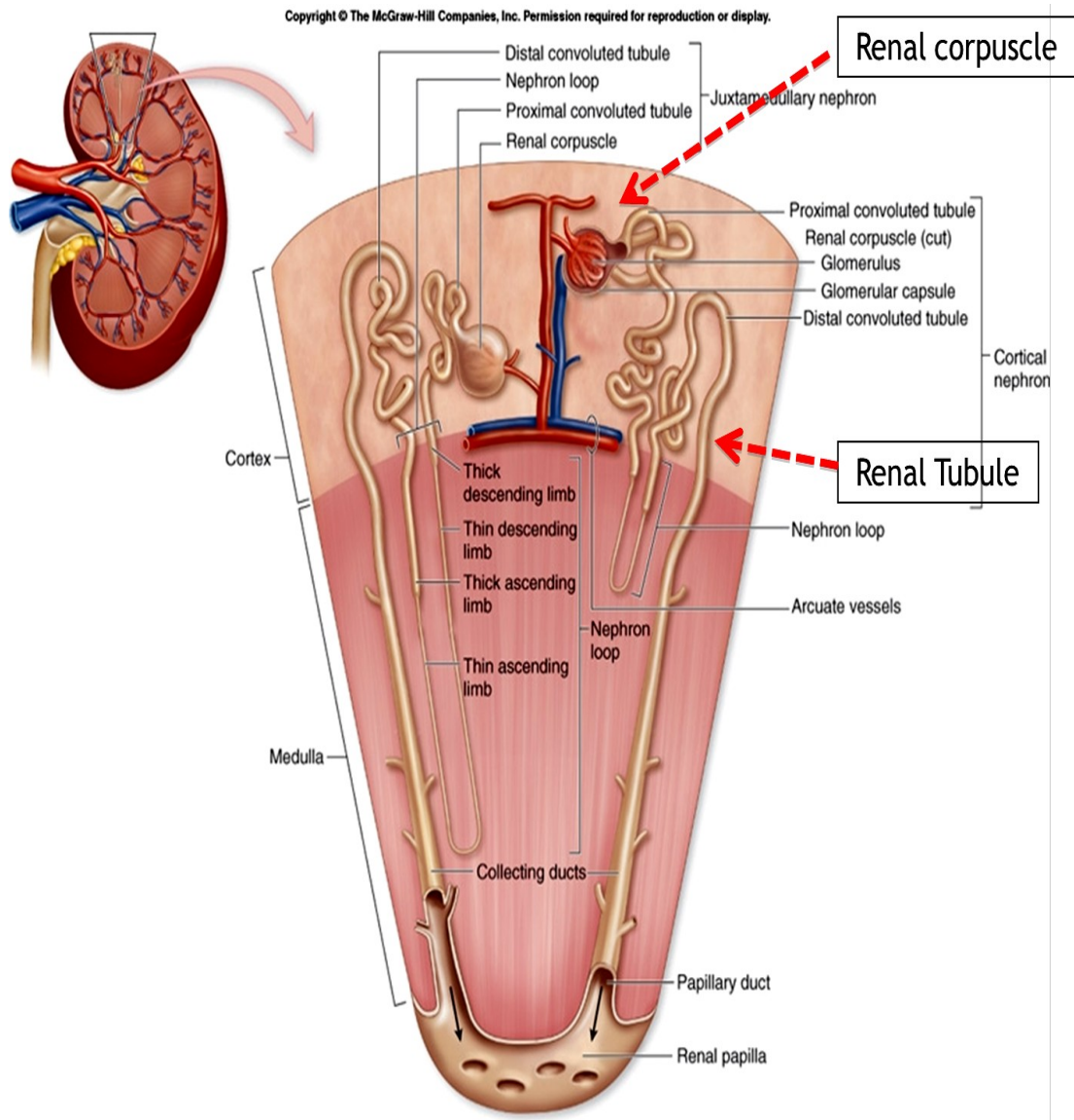
Functionally and embryologically, it consists of two parts:

Nephron

Collecting tubule

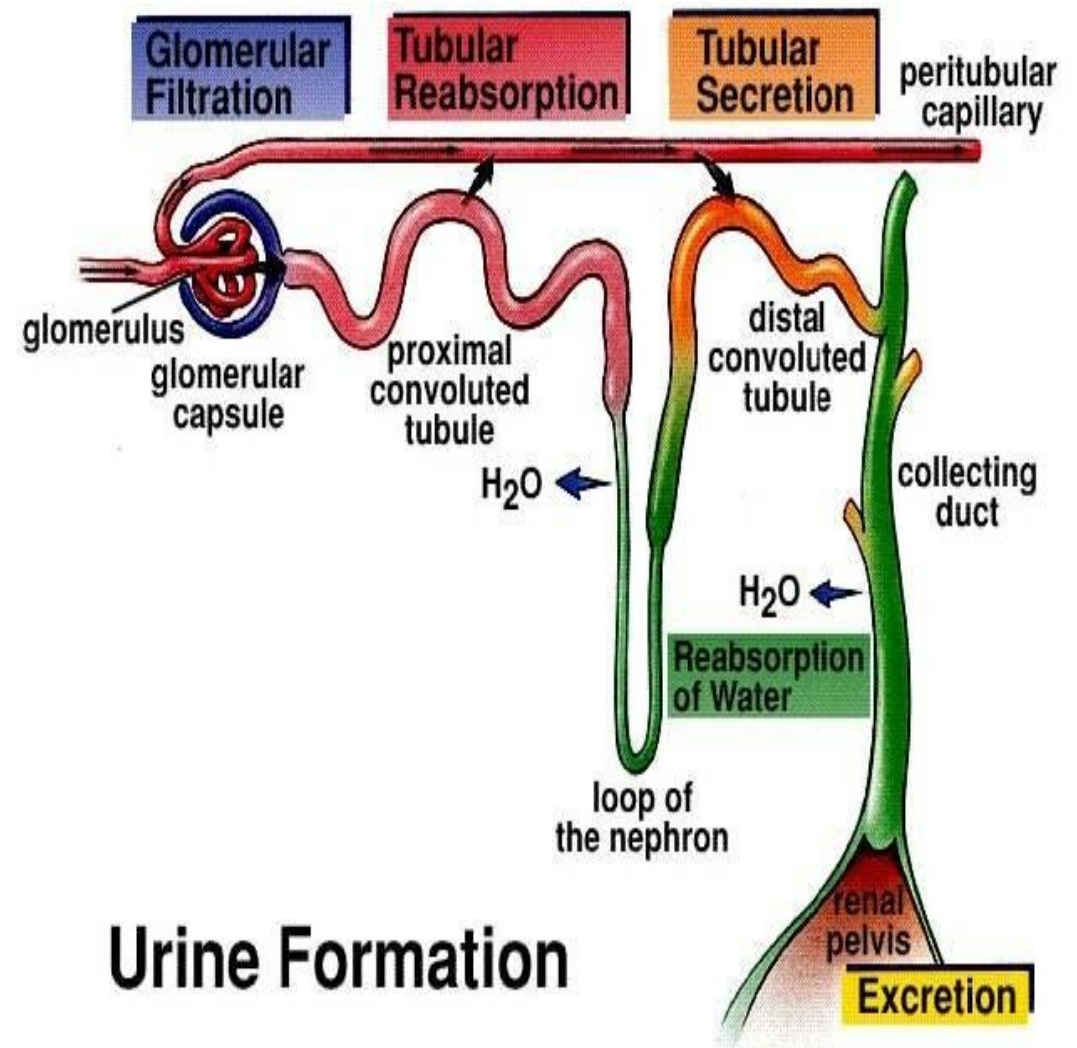


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Urine Formation

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Nephron



Each kidney is formed of about 1 million nephrons

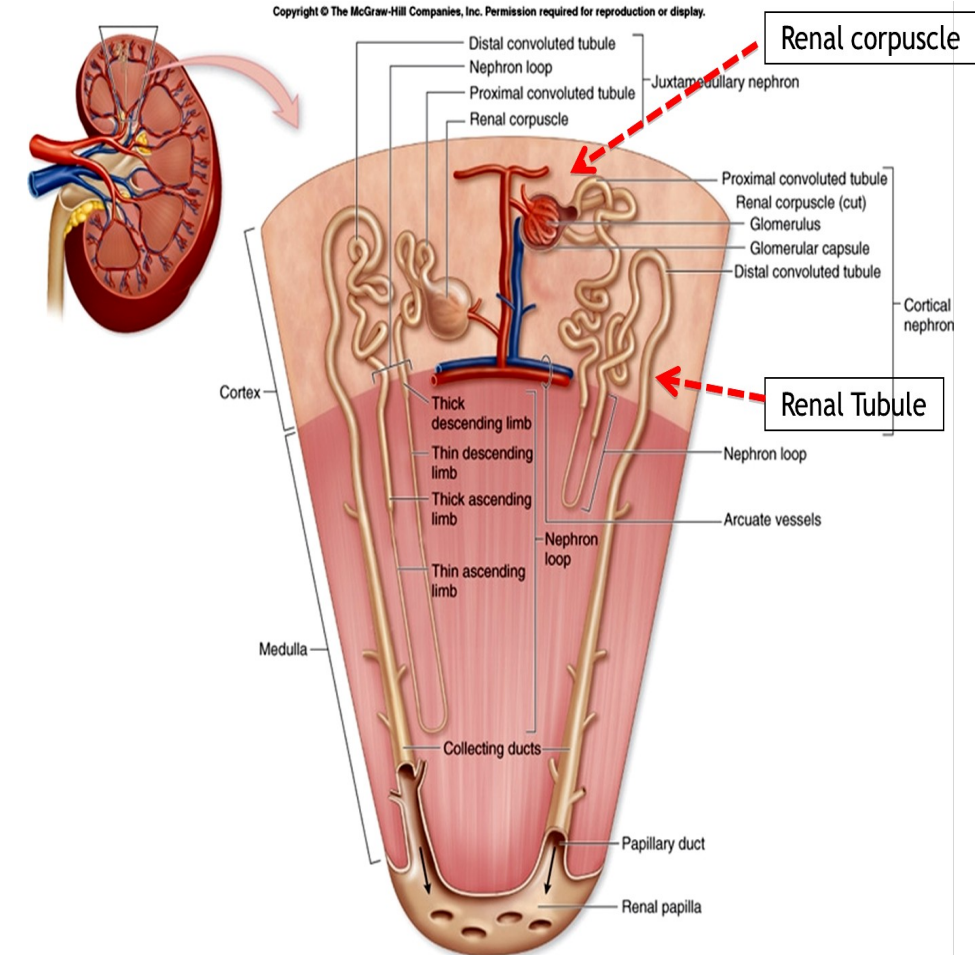
It is divided into:

- Renal corpuscle.
- Proximal convoluted tubule "PCT".
- Loop of Henle.
- Distal convoluted tubule "DCT"

There are two types:

Cortical nephron: short with short loop of Henle.

Juxtamedullary nephron: long with long loop of Henle.



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A) Renal Corpuscle

"Malpighian corpuscle"



It is spherical body.

It has two poles:

- **Urinary “tubular” pole** where the PC starts

- **Vascular pole** where arterioles enter and leave

It is formed of:

- 1- Bowman's capsule.
- 2- Glomerulus.
- 3- Mesangium.

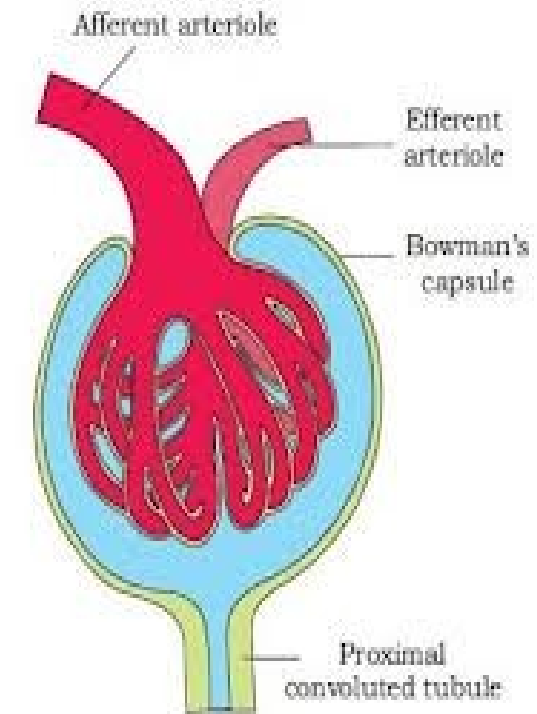


Figure 4. Malpighian body (renal corpuscle)

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1) Bowman's capsule



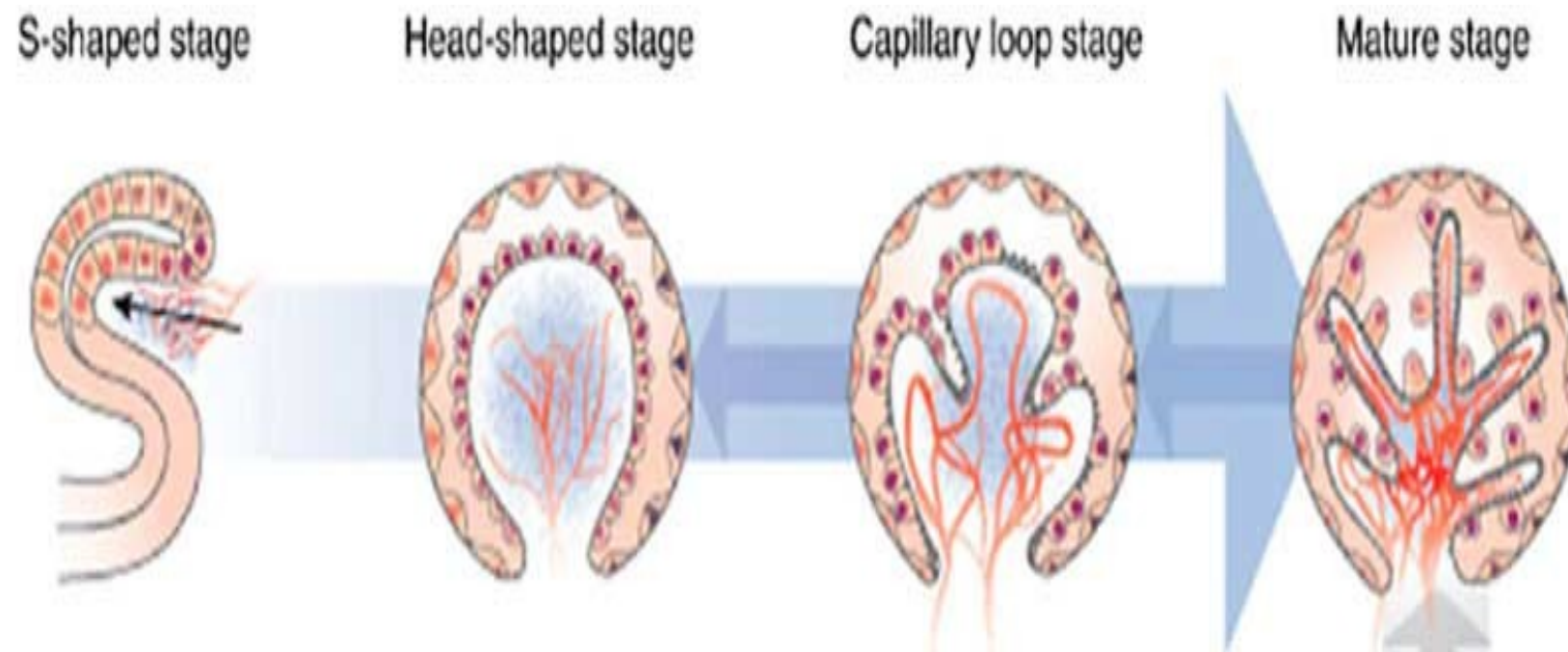
- Double walled chamber invaginated by glomerular capillaries.

Outer layer: parietal layer

- Formed of simple squamous epithelium.
- Continuous with PCT at urinary pole.



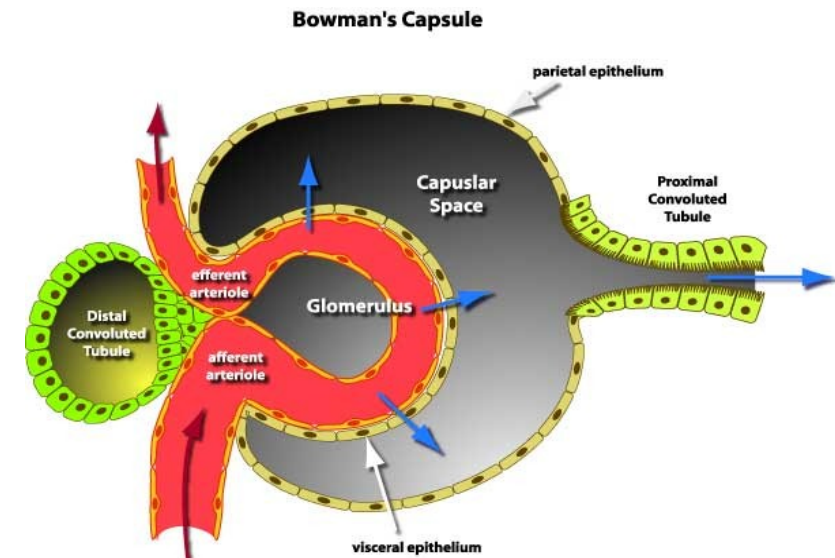
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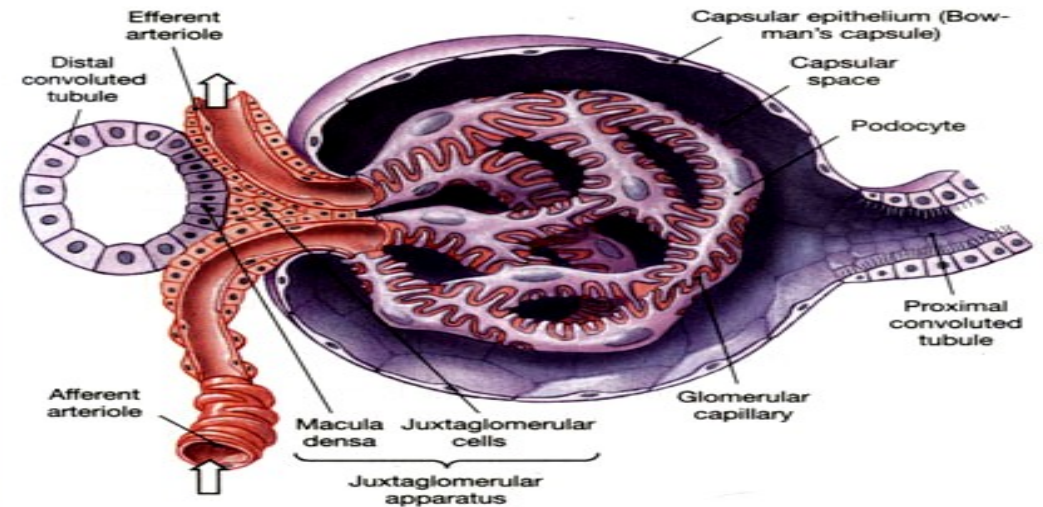
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Visceral layer:

- Lie closely to the glomerular capillaries.
- The space between visceral & parietal layer is called **Bowman's space** which receive the fluid filtrated.
- Lining cells are called **Podocytes.**



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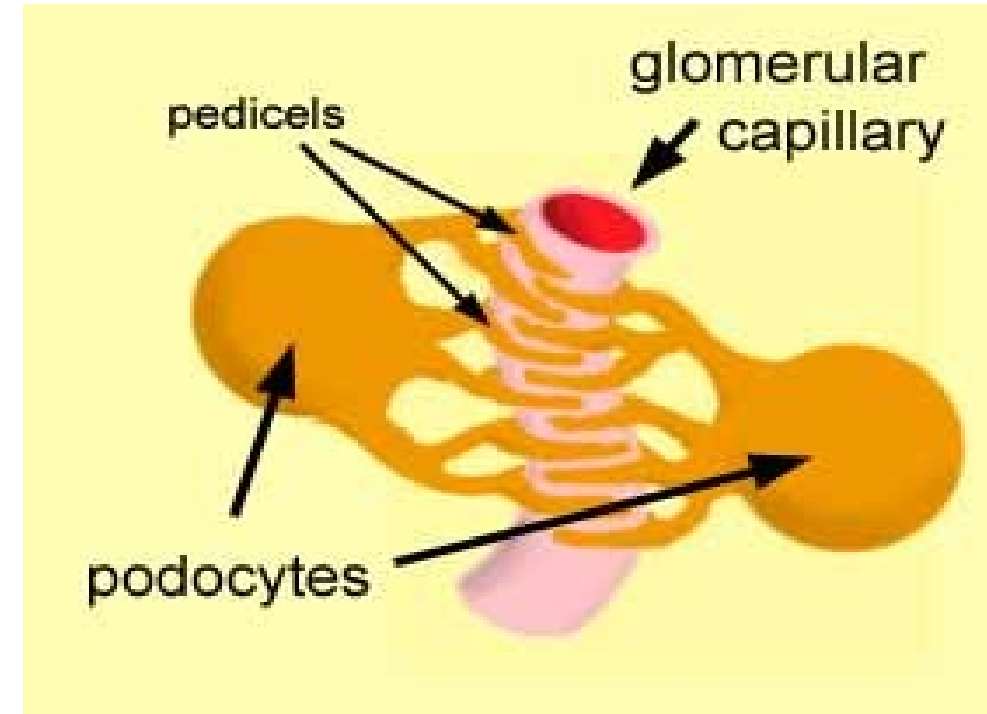
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PODOCYTES

"Glomerular epithelium"

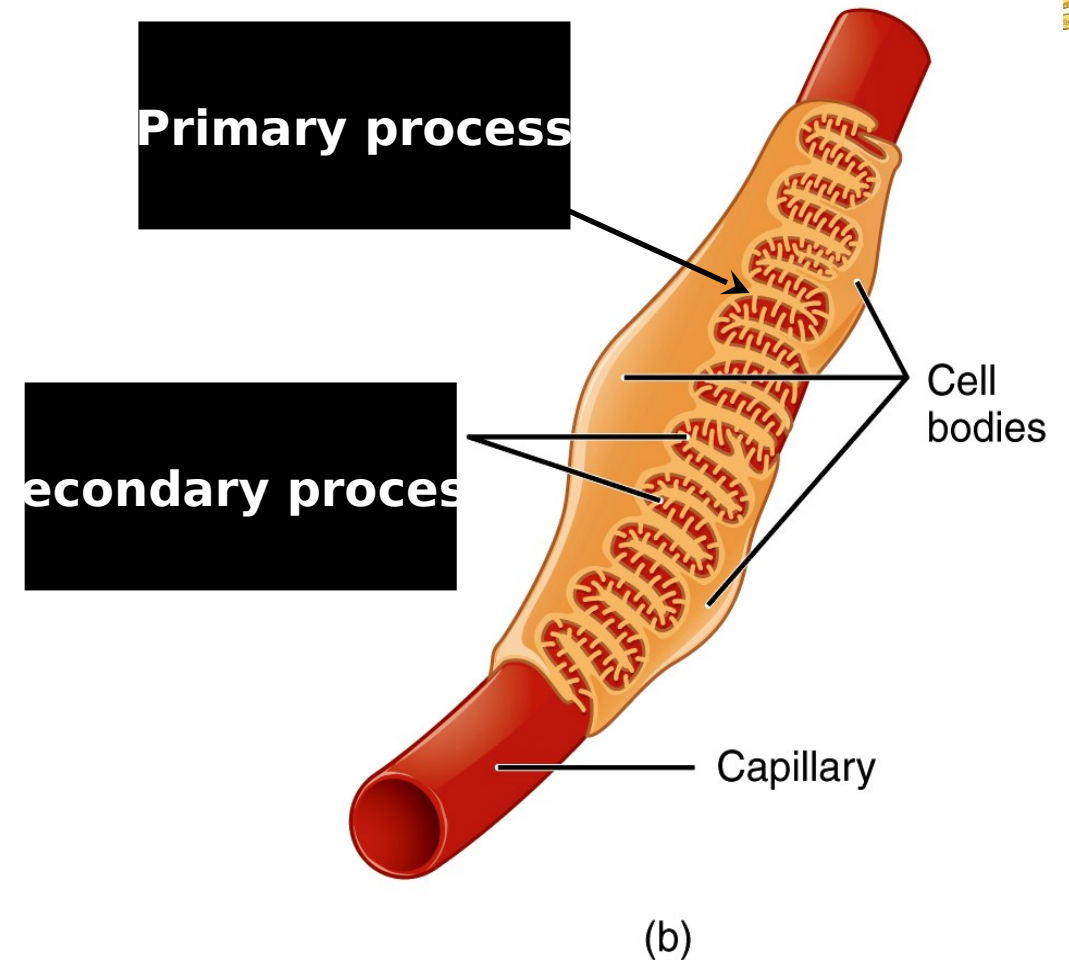


- Modified epithelium that line **visceral layer** of Bowman's capsule.
- **Stellate** in shape.
- Separated from capillary by sub-podocytic space.

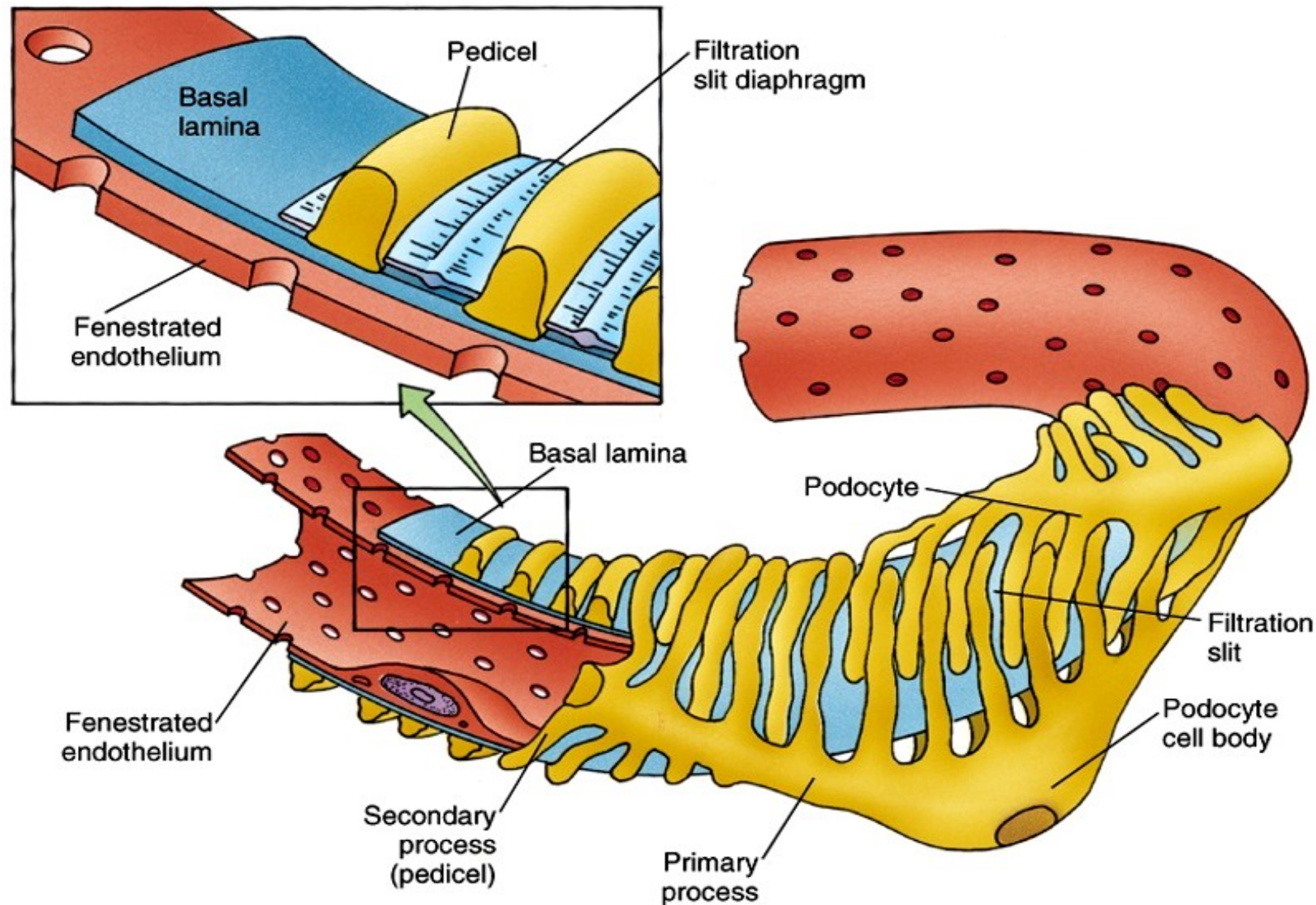


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- From cell arise **major or primary processes** to capillary loops.
- From 1ry processes arise **2ry processes** called **pedicles** that grasp capillary, interdigitating with each other and in direct contact with the basal lamina.



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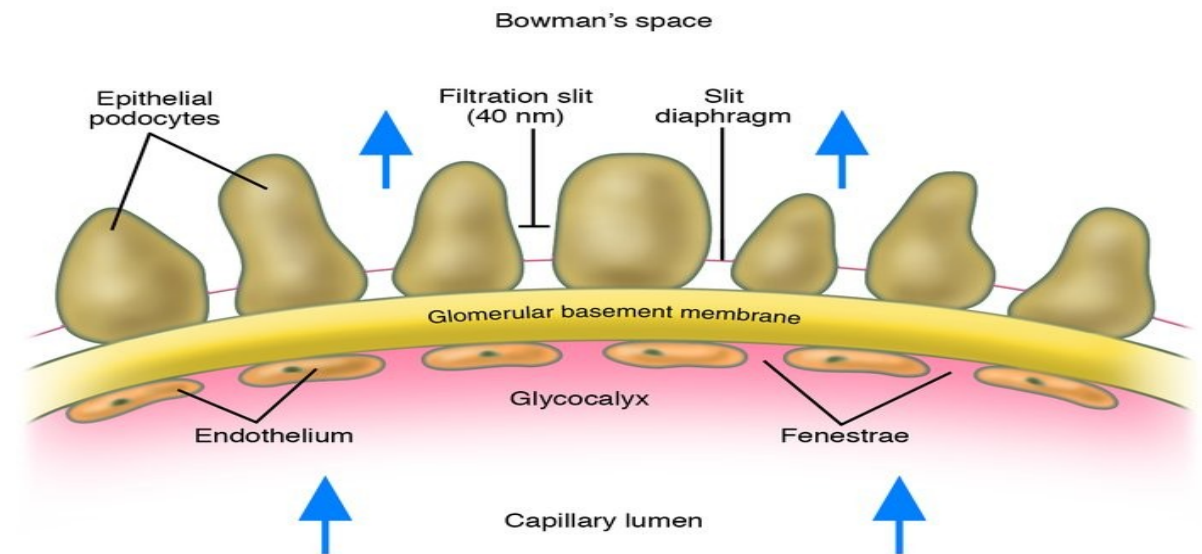
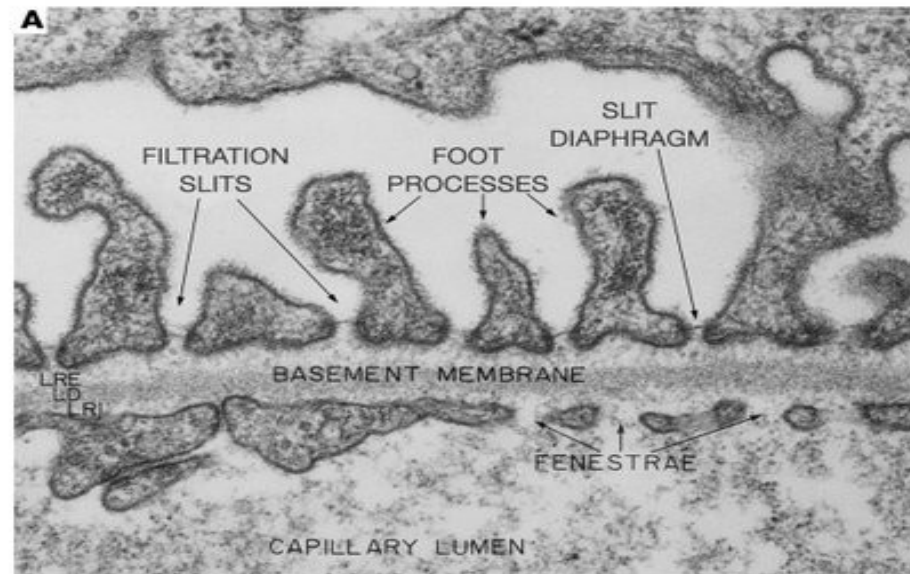


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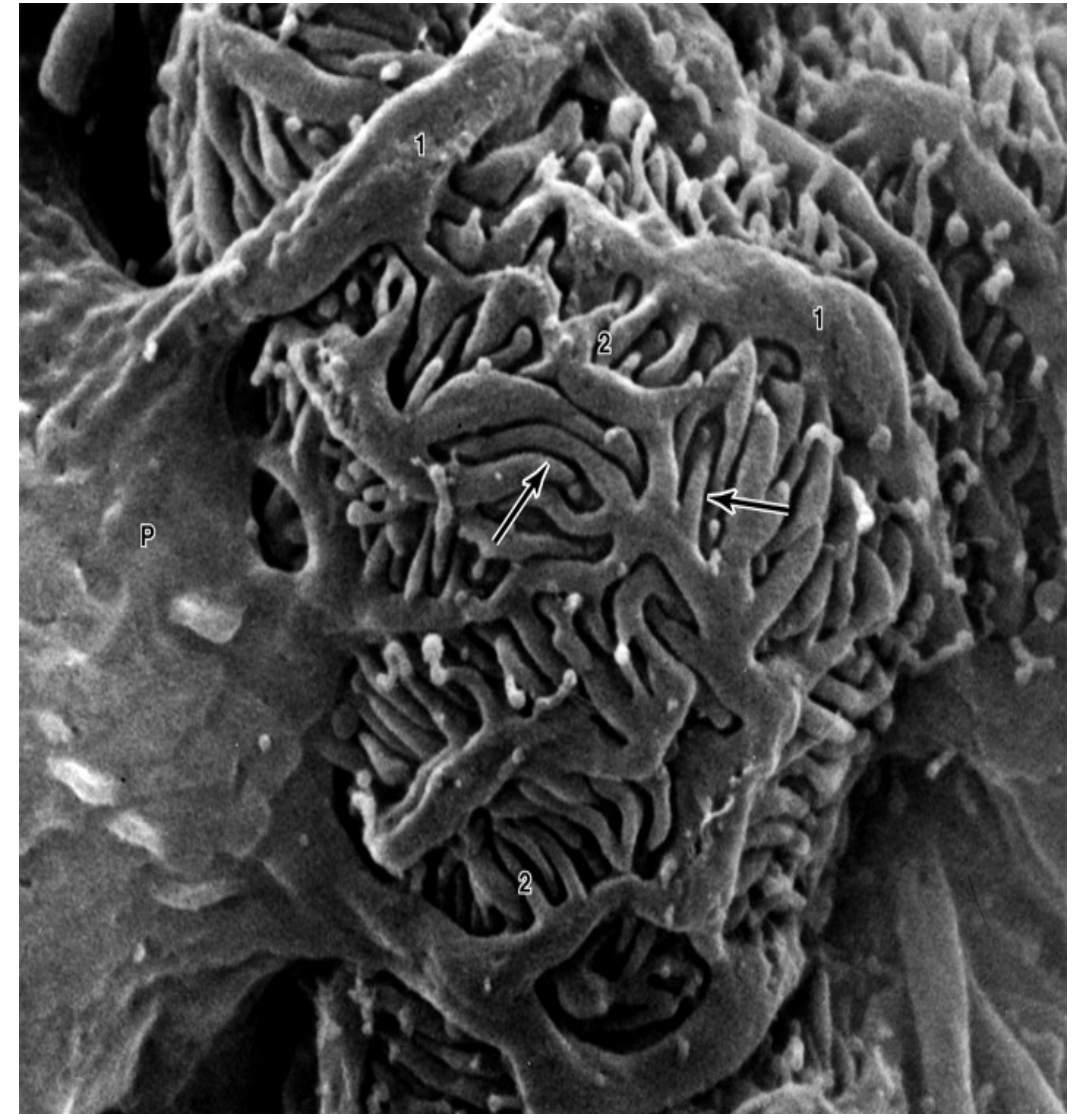
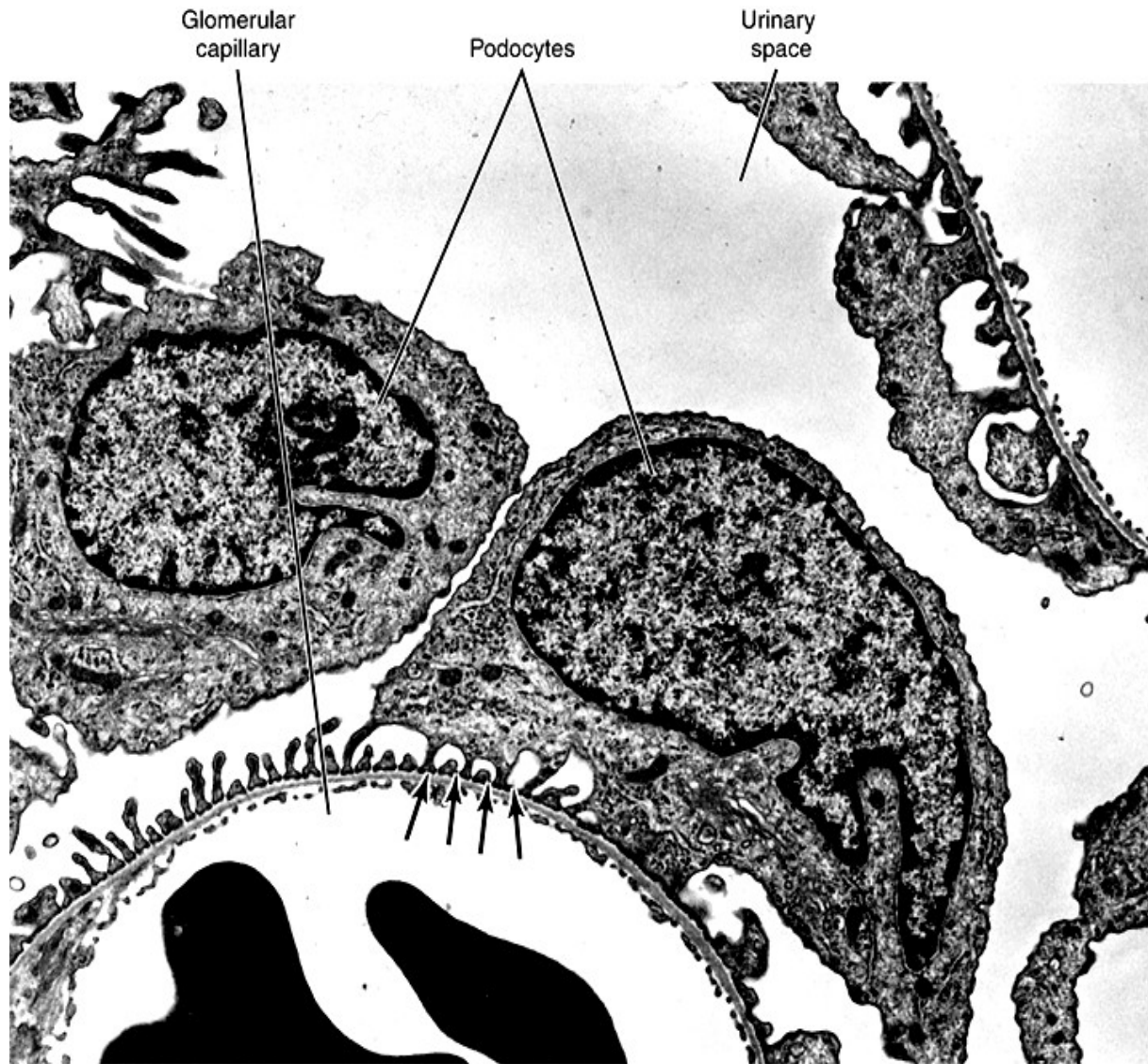


- Space between pedicles called "**filtration slit**"
- Each slit is closed by **filtration slit diaphragm** formed of **modified occluding junction**.
- **The width of the junction** between 2 adjacent pedicles varies between **20 and 50 nm**



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New Five Year Program

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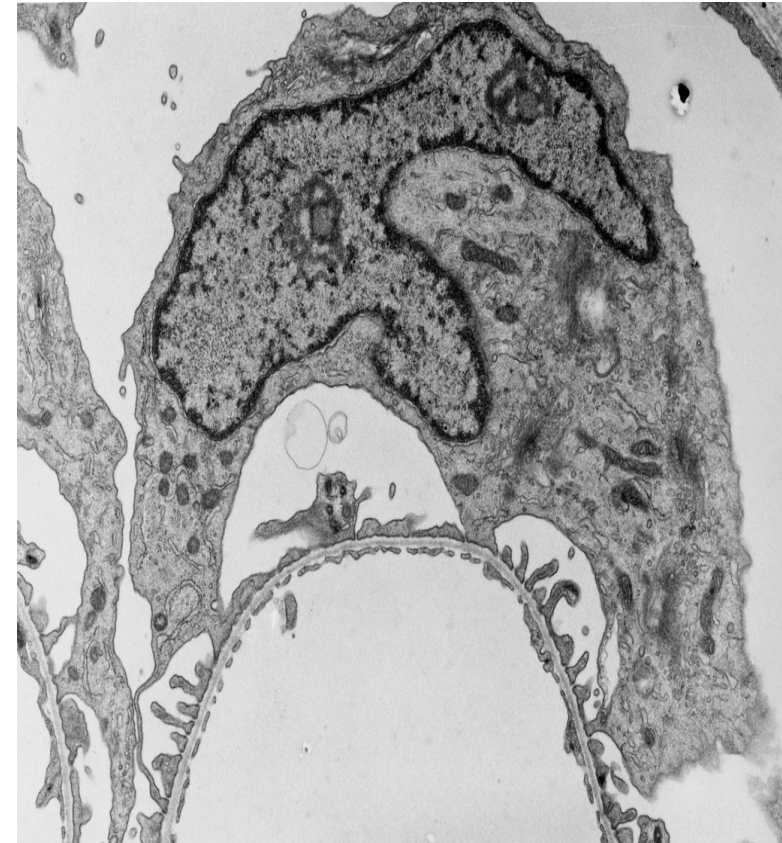
Endocrine & Genitourinary Module

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21

Podocytes by EM:

- Irregular nucleus.
- Microtubules, actin & myosin.
- rER
- Golgi.
- Ribosomes.



Function of Podocytes:

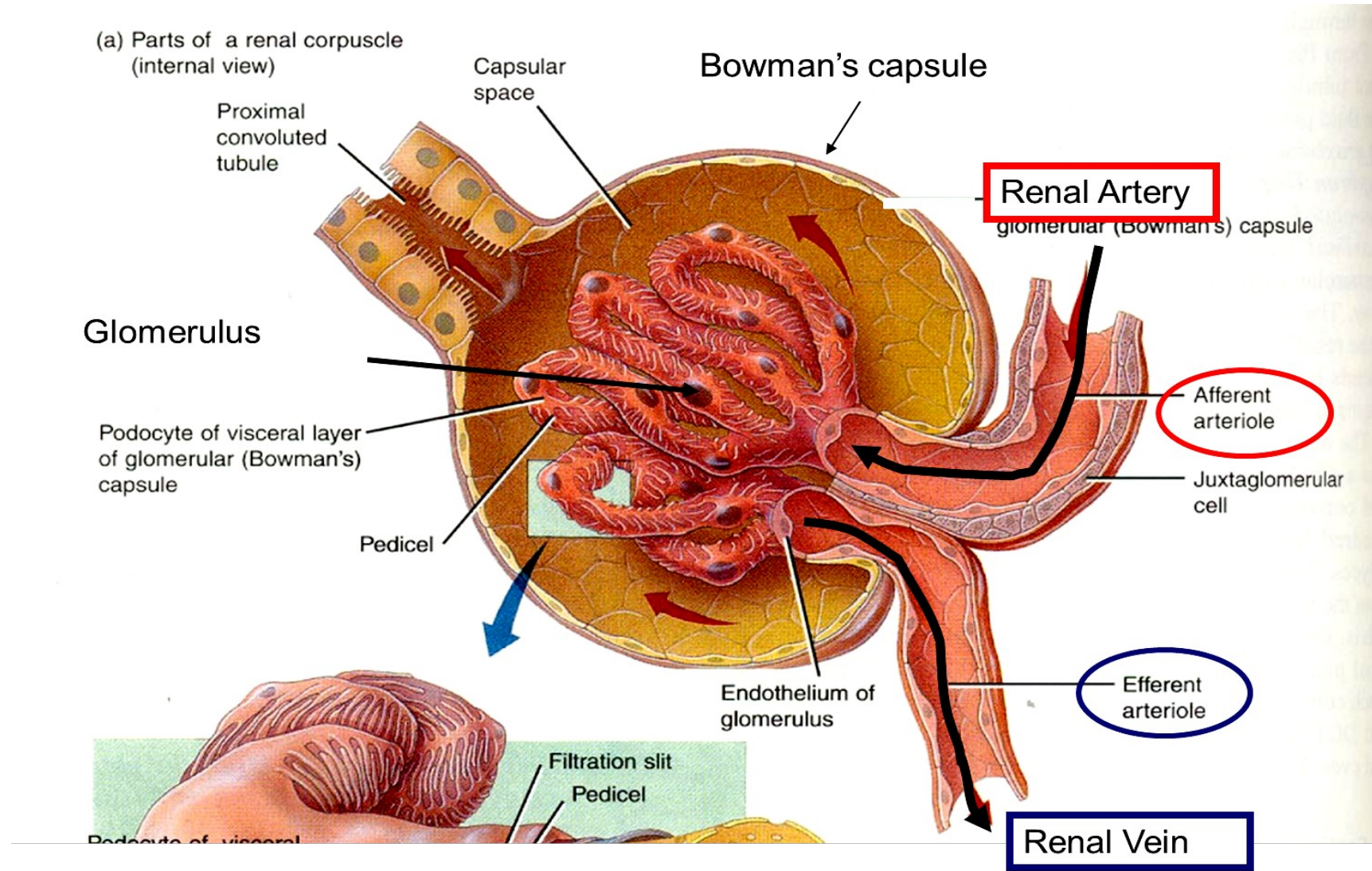
- Formation of glomerular basement membrane.

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2) Glomerular Capillaries



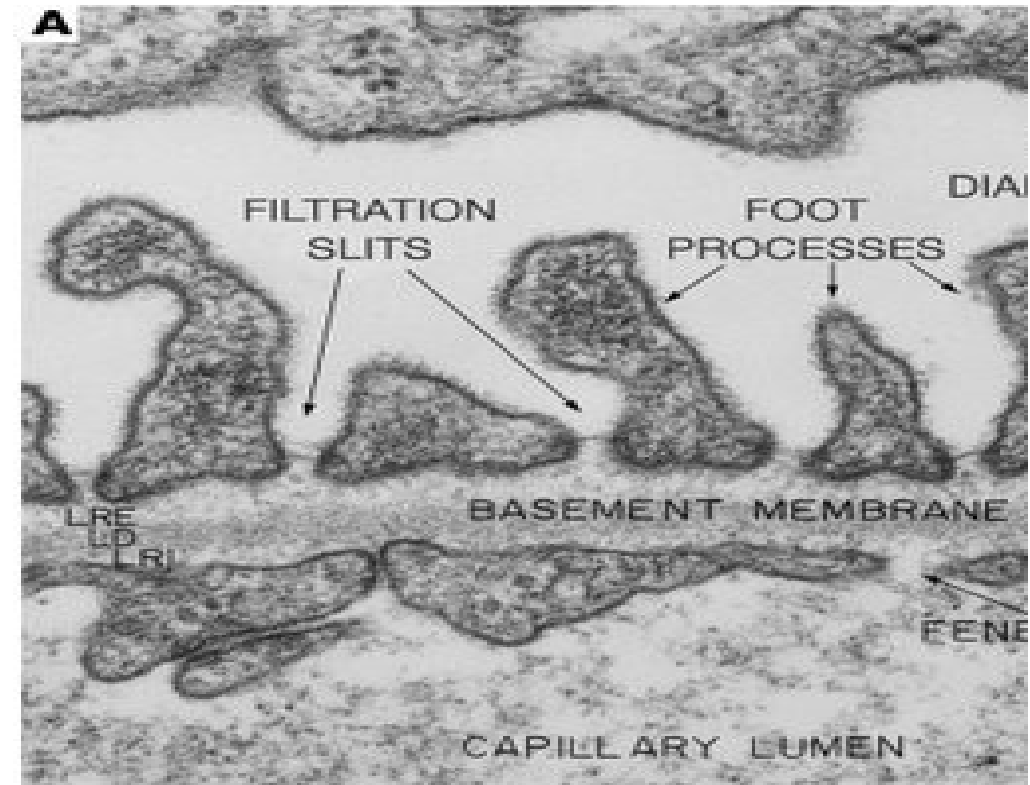
- At vascular pole **afferent arteriole** enters & **efferent arteriole** leaves
- The afferent arteriole "**non-filtered blood**" branches into 50 glomerular capillaries
efferent arteriole "**filtered blood**".



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Endocrine & Genitourinary Module

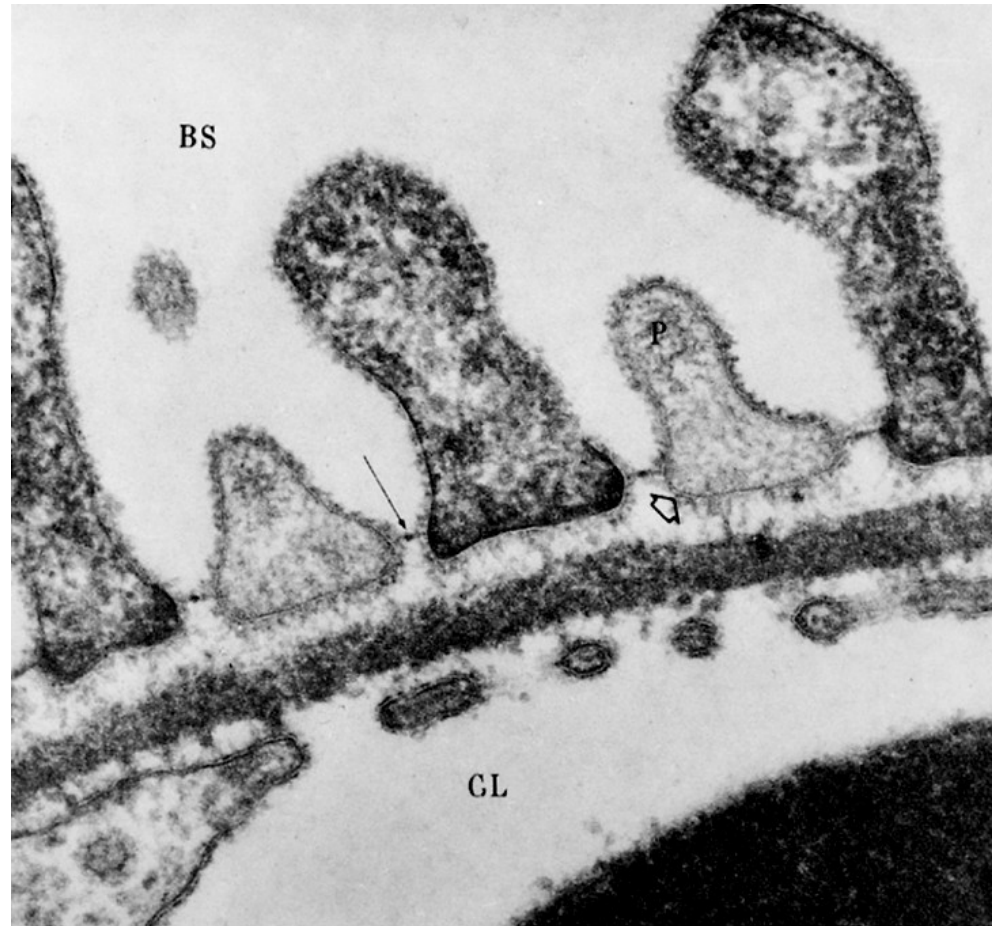


- Glomerular capillaries are lined by **simple squamous endothelium**.
- The endothelial cells are **fenestrated** & the fenestrae are **NOT** closed with diaphragm.
- The endothelial cells rest on the glomerular basement membrane.



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Glomerular Basement Membrane



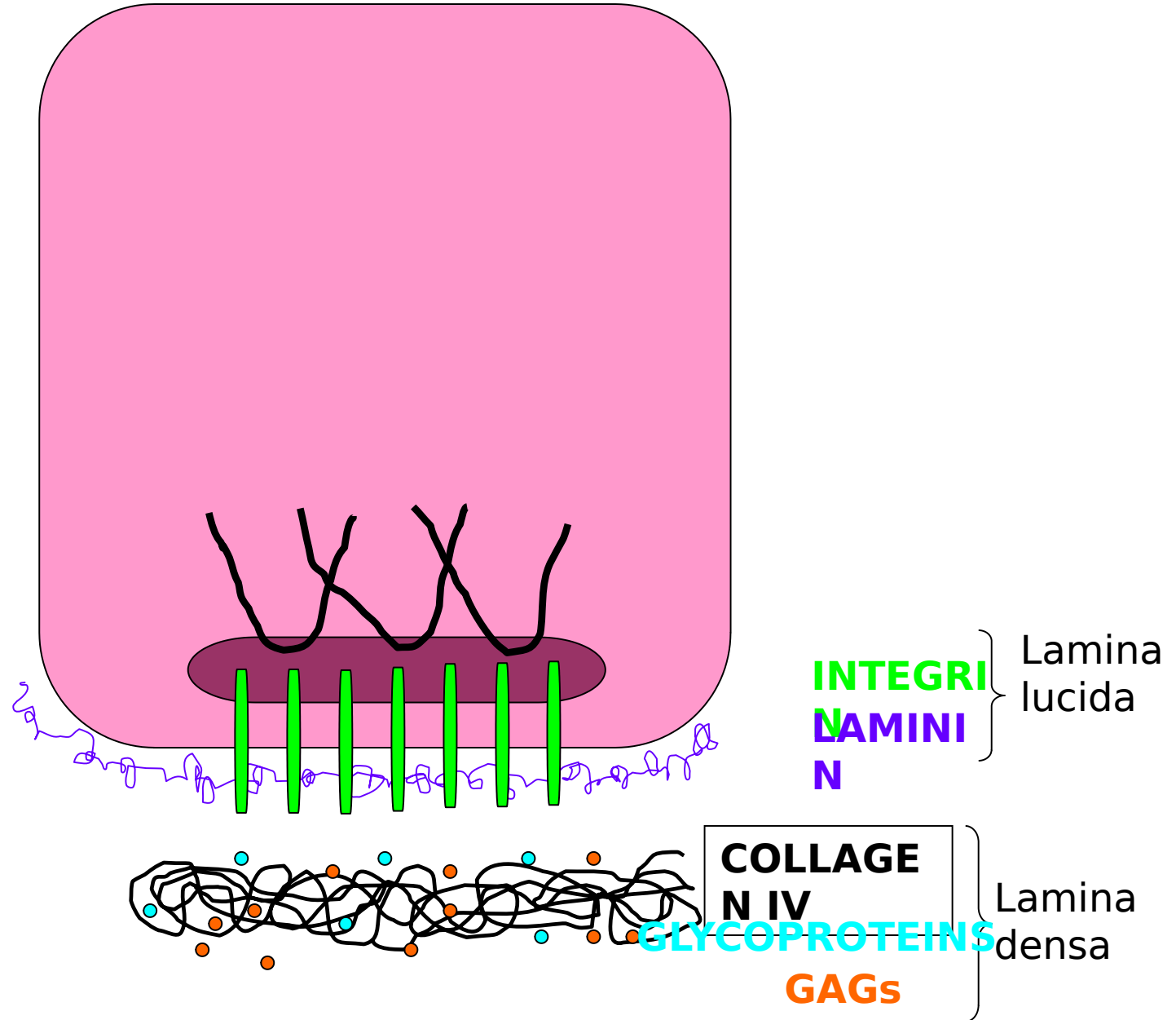
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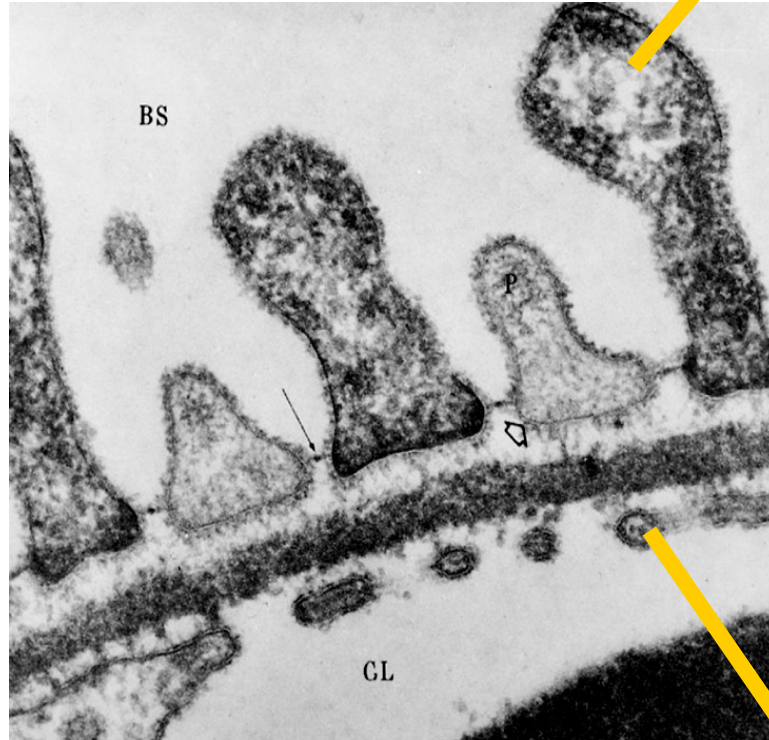
CELL

C.T.

**BASAL
LAMINA**



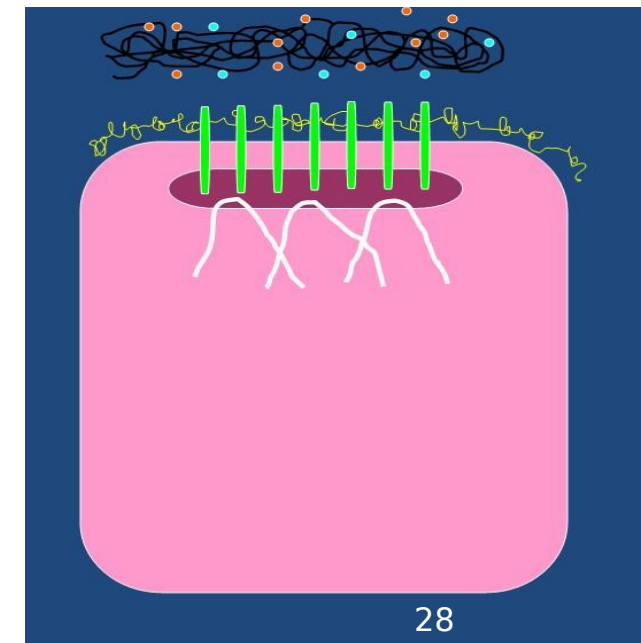
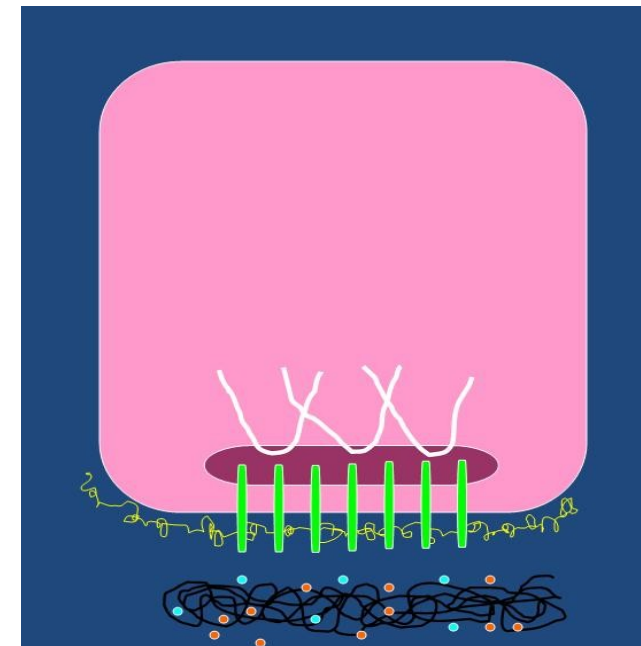
Podocyte



Gartner, L. P., Hiatt, J. L., & Gartner, L. P. (3rd). *Color textbook of histology*. Philadelphia, PA: Saunders/Elsevier

Endotheli um

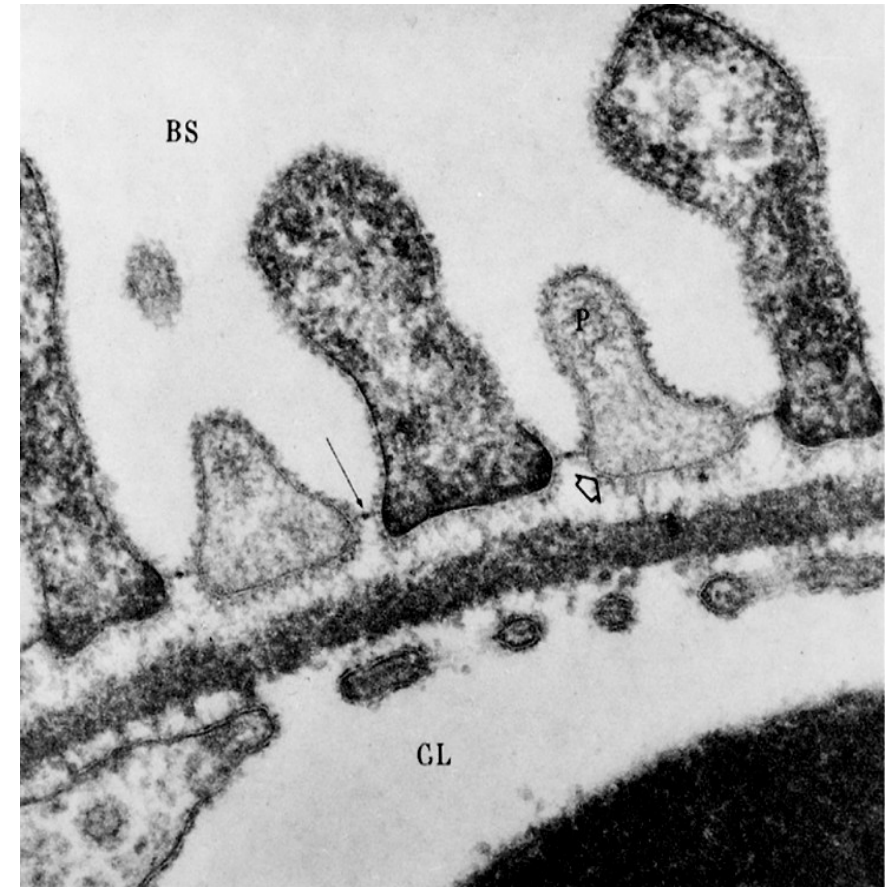
Endocrine & Genitourinary Module



Glomerular Basement Membrane



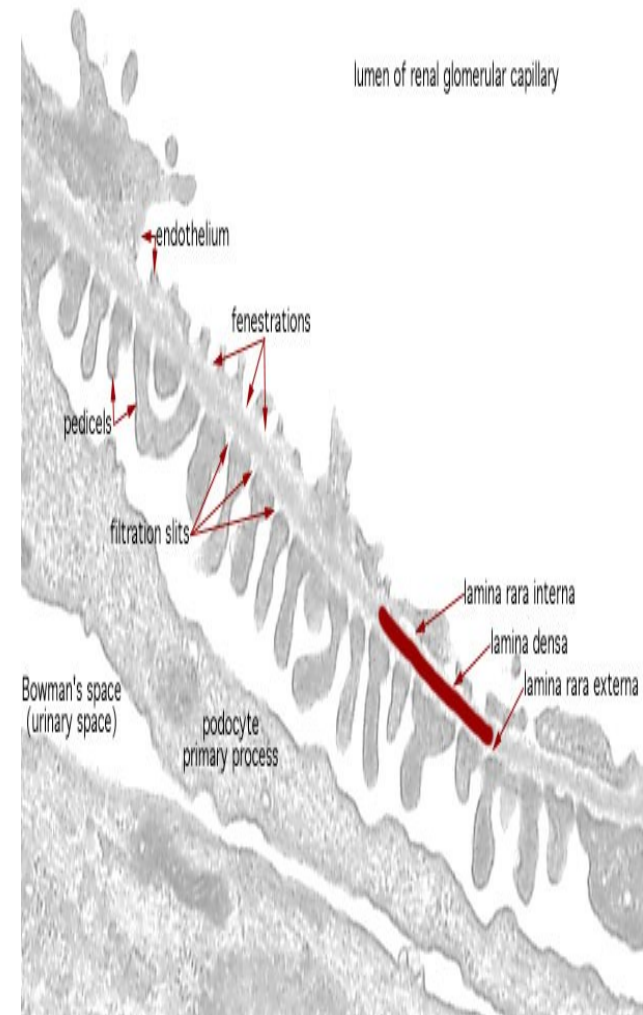
- Thick & continuous.
- 300 – 360 nm thick.
- Formed by **podocytes** and **endothelial cells**.
- Renewed by **mesangial cell**.



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Gartner, L. P., Hiatt, J. L., & Gartner, L. P. (3rd). *Color textbook of histology*. Philadelphia, PA: Saunders/Elsevier

- **It is formed of 3 layers:-**
 - **Central electron dense layer:-**
 - Lamina densa.
 - Formed of collagen IV
 - Acts as **physical** barrier “restrict passage of **large proteins**”
 - **Outer & inner electron lucent layers:-**
 - **Lamina rara externa**: adjacent to **podocyte**
 - **Lamina rara interna**: adjacent to **endothelial cells**
 - It acts as **charge** barrier “restrict passage of **organic anions**”

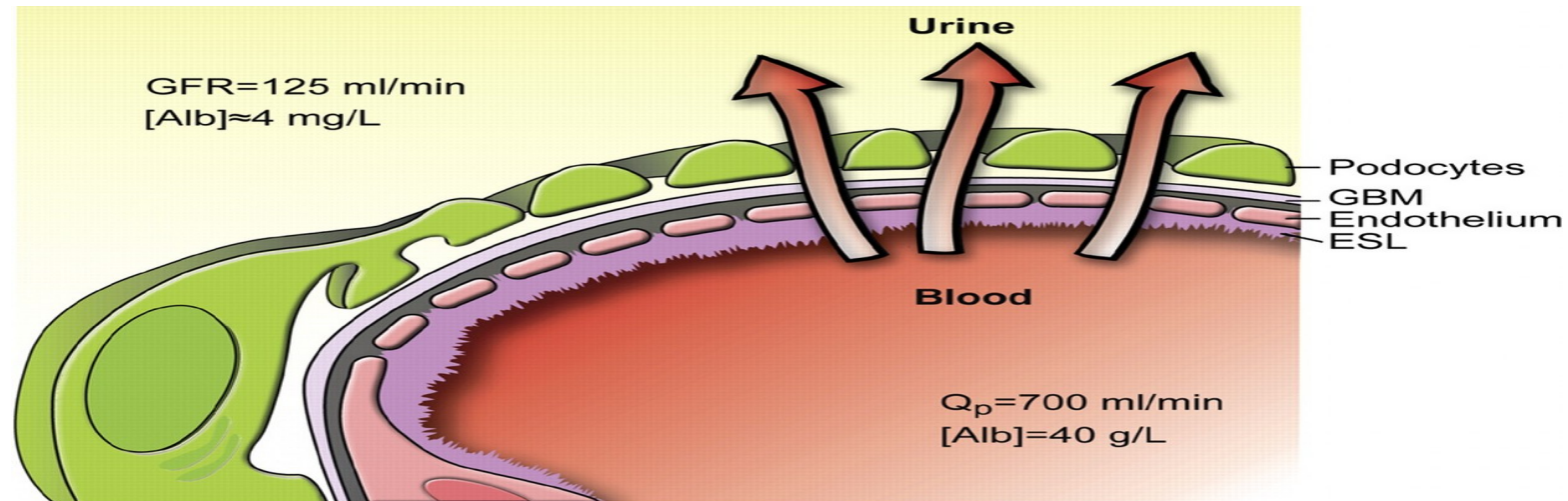


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- Function: *Filtration Barrier OR*
Blood Renal Barrier

It is the most substantial “important” part of the filtration barrier that separates blood from the capsular space.

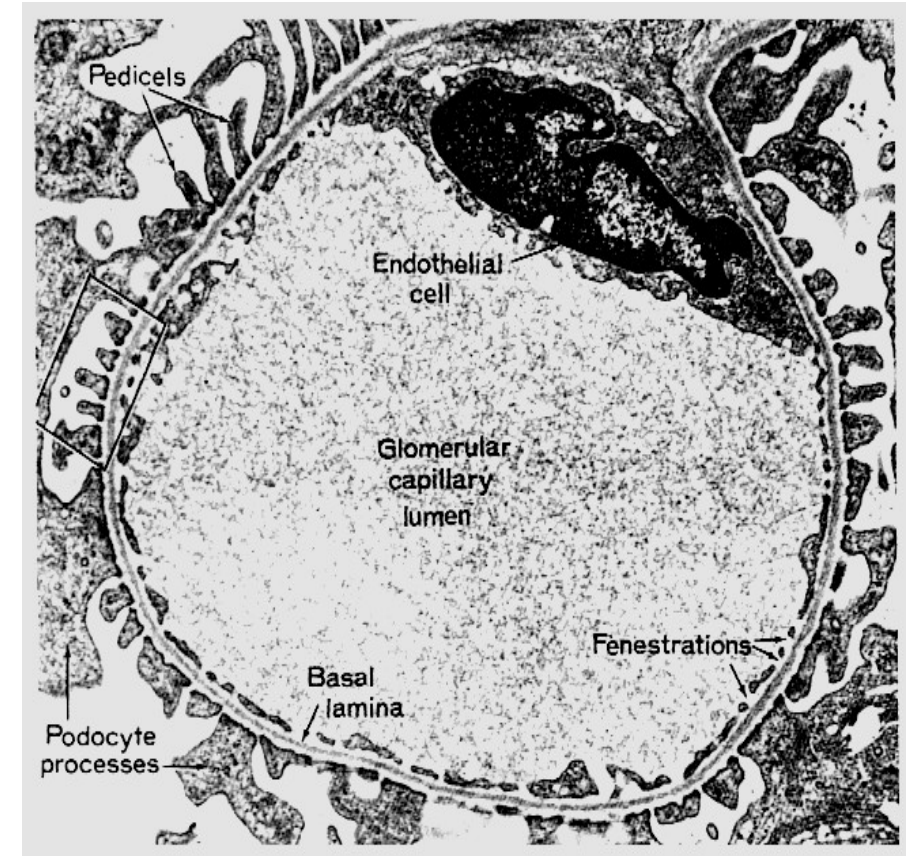


<https://www.google.com.eg/>

Blood Renal Barrier



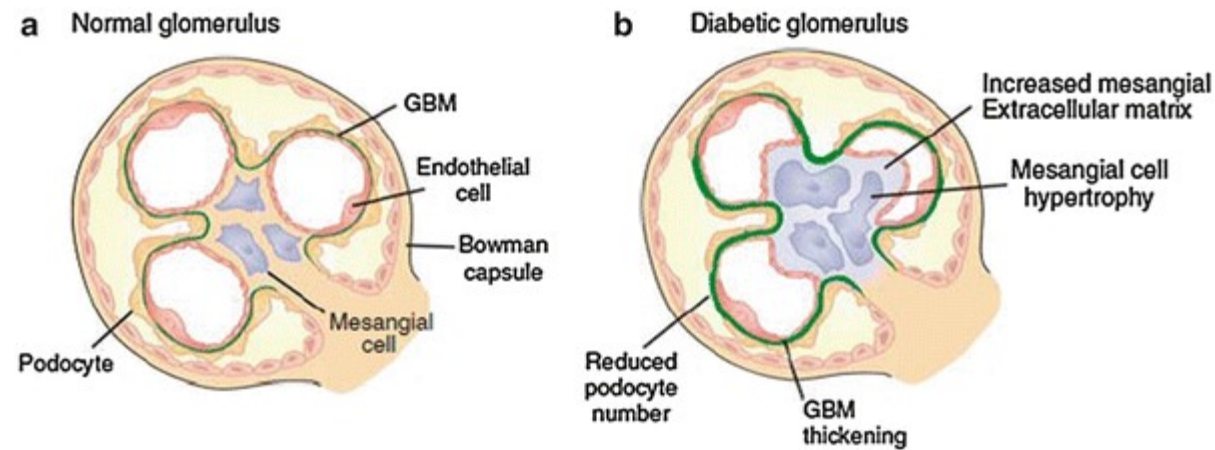
- **Endothelial cells:** act as sieve plate “block blood cells and platelets”
- **Glomerular basement membrane:** Allow passage of small molecules & stop passage of large one as albumin.
- **Filtration slit diaphragm:** hold back small proteins



[https://www.google.com/eg/url?sa=i&source=images&cd=&ved=2ahUKEwiOto7P08HkAhUR8uAKHZ5cA68QjRx6BAgBEAQ&url=https%3A%2F%2fact.downstate.edu%2Fcourseware%2Fhistomanual%2Fslides%2Fbig%2Flab_14_04.html&psig=AOvVaw0FXExOn8gRM6GO2CHV0XMs&ust=1568046783872901](https://www.google.com/eg/url?sa=i&source=images&cd=&ved=2ahUKEwiOto7P08HkAhUR8uAKHZ5cA68QjRx6BAgBEAQ&url=https%3A%2F%2Fact.downstate.edu%2Fcourseware%2Fhistomanual%2Fslides%2Fbig%2Flab_14_04.html&psig=AOvVaw0FXExOn8gRM6GO2CHV0XMs&ust=1568046783872901)



Diabetic glomerulosclerosis: there is thickening and loss of function of the glomerular basement membrane with subsequent release of proteins in urine “proteinuria”



https://media.springernature.com/lw785/springer-static/image/chp%3A10.1007%2F978-3-642-37078-6_149/MediaObjects/312468_2_En_149_Fig2_HTML.gif

Key Points



- Definition of Renal Pyramids, Columns of Bertin, Medullary rays, Renal lobes & Renal lobules.
- Difference between Uriniferous tubule & Nephron.
- Components of the Nephron.
- Histological structure of Renal Corpuscle
- The difference between Parietal and Visceral layer of Bowman's capsule.
- Histological structure of the glomerular capillaries
- Correlation between the histological structure of Blood Renal barrier and its function with reference to its medical application.

Summary



- ❑ General structure of the kidney including cortex, medulla, lobes and lobules.
- ❑ Structure and correlated functions of the different components of the uriniferous tubules.
- ❑ Structure and correlated functions of components of the nephron.
- ❑ Structure and correlated functions of components of the renal corpuscle.
- ❑ The renal corpuscle is formed of Bowman's capsule and a glomerulus.
- ❑ Structure and correlated functions of the podocytes and its role in turnover of the glomerular basement membrane.
- ❑ Structure of the glomerular blood capillaries and their functions.
- ❑ The glomerular basement membrane is formed of three laminae.
- ❑ Structure and functions of components of blood renal barrier.

Lecture Quiz



1. A nephron includes all of the following Except:

- (a) Renal corpuscles.
- (b) Distal convoluting tubules.
- (c) Loop of Henle.
- ☒ (d) Collecting tubules.
- (e) Proximal convoluted tubule.

2. The visceral layer of the renal corpuscle is formed of:

- (f) Mesangial cells.
- ☒ (g) Endothelial cells.
- (h) Podocytes.
- (i) Juxta-glomerular cells.
- (j) Simple squamous cells.

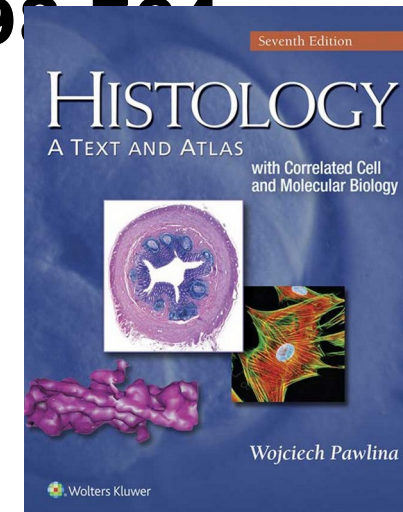
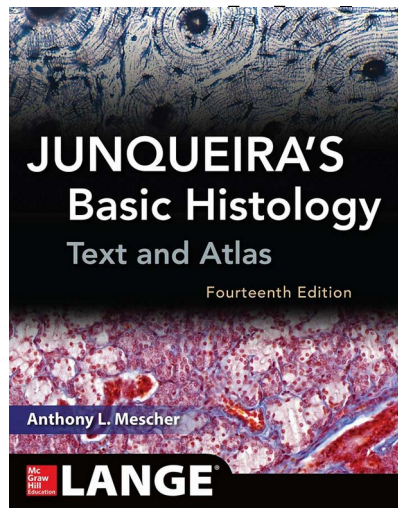
SUGGESTED TEXTBOOKS



**1. Junqueira's Basic Histology: Text and Atlas, Fourteenth Edition
by Anthony Mescher (2016) p. 393-399**

2. Histology a text and atlas with correlated cell and molecular

biology by W. Pawlina (2016) p. 690-704



**THANK
YOU**

